Vorläufige Prototypenbestätigung / *Preliminary prototype confirmation*

Nr. / *No.*:

968/GI 1603.00/22

Netzintegration von Erzeugungseinheiten und -anlagen

Grid integration of power generating units and systems

Antragsteller / *Applicant*	SolaX Power Network Technology (Zhejiang) Co., Ltd. No.288, Shizhu Road, Tonglu Economic Development Zone, Tonglu City, Zhejiang Province, 310000 P.R. China
Zertifizierstelle / *Certification Body*	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln, Deutschland / *Germany*
Produkttyp / *Product type*	Wechselrichter / Energieerzeugungseinheit (EZE) Typ 2 *Inverter / Power Generating Unit (PGU) Type 2*
Modell / *Model*	**X3-FTH-80K, X3-FTH-100K, X3-FTH-110K, X3-FTH-120K, X3-FTH-125K, X3-FTH-136K-MV, X3-FTH-150K-MV**
Beschreibung / *Description*	Die EZE kann innerhalb ihrer Betriebsbereiche Leistung und Blindleistung bereitstellen / beziehen. Darüber hinaus bietet sie eine dynamische Blindstromeinspeisung bei Netzfehlern mit eingebauter Schutzfunktion. / *The PGU can supply/receive power and reactive power within its operating ranges. It also provides dynamic reactive current feed-in during grid fault with equipped protective function.*
Normen / *Standards*	VDE-AR-N 4110:2018-11, VDE-AR-N 4120:2018-11 FGW TR 8 / *TG8*, Rev.9 (2019-02-01)
Erklärung / *Declaration*	Die TÜV Rheinland Industrie Service GmbH bestätigt, dass es sich bei der genannten Energieerzeugungseinheit (EZE) Typ-2 nach VDE-AR-N 4110, sowie gemäß FGW TR 8, um einen Prototypen handelt, der in der Lage ist die technischen Anforderungen der Normen zu erfüllen. Es wird davon ausgegangen, dass die Anforderungen der FGW TR8 im Rahmen einer Zertifizierung erfüllt werden. / *TÜV Rheinland Industrie Service GmbH confirms that the mentioned Power Generating Unit (PGU Type-2) is a prototype according to VDE-AR-N 4110, as well as according to FGW TG 8, which is able to meet the technical requirements of the standards. It is assumed that the requirements of FGW TG8 are fulfilled within the scope of a certification*.
Inbetriebnahme der ersten EZE / *Commissioning of the first PGU*	--
Datum / *Date*	2022-11-18
Gültig bis / *Valid until*	2024-11-18 Die Details zur Gültigkeit im Kapitel 1.3 sind entsprechend zu beachten. / *The details on validity in chapter 1.3 must be observed accordingly.*

Diese Prototypenbestätigung darf nicht auszugsweise verwendet werden.

This prototype confirmation may not be used in extracts.

Köln, 2022-11-18
TÜV Rheinland Industrie Service GmbH
Am Grauen Stein, D-51105 Köln

M. Sc. Pascal Krey
Specialist Certifier

M. Sc. Armin Kerperin
Assessor

1. Aufgabenstellung / *Task*

Im Rahmen dieser Prototypenbestätigung wird auf Grundlage herstellerspezifischer Dokumente überprüft, ob die genannte Energieerzeugungseinheit (EZE) die Anforderungen gemäß [N1] bis [N3] erfüllen kann.

As part of this prototype confirmation, it is checked on the basis of manufacturer-specific documents whether the named power generating unit (EZE Type-2) can meet the requirements according to [N1] to [N3].

1.1. Normen und Technische Richtlinien / *Standards and technical guidelines*

[N1] Technical Guideline for the connection of customer systems to the medium-voltage network and their operation (TAR medium voltage / VDE-AR-N 4110: 2018-11)

[N2] Technical Guideline for the connection of customer systems to the high-voltage network and their operation (TAR high voltage / VDE-AR-N 4120: 2018-11)

[N3] Technical guideline for generating units and systems part 8 revision 09 of the Fördergesellschaft Windenergie und andere Erneuerbare Energien e.V. (FGW TG8 Rev. 9)

1.2. Für die Bestätigung verwendete Dokumente / *Documents supplied for confirmation*

Für die Bewertung der EZE wurden u. a. Informationen aus den folgenden herstellerspezifischen Dokumenten entnommen.

For the evaluation of the PGU, e.g. Information taken from the following manufacturer-specific documents.

[D1] SolaX Power Network Technology (Zhejiang) Co., Ltd.
Declaration of VDE-AR-N 4110&4120
Datum / *Date*: 2022-11-11

[D2] SolaX Power Network Technology (Zhejiang) Co., Ltd.
Application for Certification
Datum / *Date:* 2022-11-04

1.3. Gültigkeit der Prototypenbestätigung / *Validity of prototype confirmation*

Die Gültigkeit der ausgestellten Prototypenbestätigung beschränkt sich gemäß VDE-AR-N 4110 und VDE-AR-N 4120 auf zwei Jahre nach Inbetriebsetzung des ersten Prototypen. Da zurzeit noch keine EZE von diesem Typ in Betrieb genommen worden ist, handelt es sich um eine vorläufige Prototypenbestätigung. Diese Prototypenbestätigung ist nach Inbetriebnahme des ersten Prototypen entsprechend zu revidieren und die Gültigkeit ist auf zwei Jahre nach Inbetriebsetzung der ersten EZE dieses Prototypen zu beschränken.

The validity of the prototype confirmation issued is limited to two years after commissioning of the first prototype in accordance with VDE-AR-N 4110 and VDE-AR-N 4120. Since no PGU of this type has currently been commissioned, this is a provisional prototype confirmation. This prototype confirmation must be revised accordingly after commissioning of the first prototype and the validity must be limited to two years after commissioning of the first PGU of this prototype.

2. Prototypenregelung nach FGW TR 8 / *Prototype regulation according to FGW TG 8*

In diesem Abschnitt wird überprüft, ob es sich bei der EZE gemäß FGW TR 8 [N2] um einen Prototyp handelt. Nach [N2] ist ein Prototyp das erste Betriebsmittel eines Typs, welches wesentliche technische Weiterentwicklungen oder Neuerungen aufweist, sowie alle weiteren Betriebsmittel dieses Typs, die innerhalb von zwei Jahren nach Inbetriebsetzung des ersten Betriebsmittels dieses Typs in Betrieb gesetzt wurden. Die Regelung und Fristen von Betriebsmittelprototypen in einer EZE können den Netzanschlussregeln (NAR) entnommen werden.

In this section, it is checked whether the mentioned PGU is a prototype according to FGW TG 8 [N2]. According to [N2], the definition of the prototype is the first item of equipment of this type that has significant technical developments or innovations, as well as all other items of equipment of this type that were put into operation within two years after the first item of equipment of this type was in service. The rules and deadlines for equipment prototypes of PGU can be found in the grid connection guideline (NAR).

Gemäß [N1] gilt: Für Erzeugungsanlagen (EZA) mit EZE gleichen Prototyps müssen das Anlagenzertifikat und die Konformitätserklärung binnen eines Jahres, nachdem für den ersten Prototyp ein Einheitenzertifikat vorliegt, nachgereicht werden. Für Komponenten innerhalb der Erzeugungsanlage, für die ein Komponentenzertifikat erforderlich ist, kann die Prototypenregelung entsprechend angewendet werden.

According to [N1], the following applies: for power generating systems (PGS) with PGU of the same prototype, the plant certificate and the declaration of conformity must be submitted within one year after a unit certificate is available for the first prototype. The prototype regulation can be applied accordingly for components within the generating plant for which a component certificate is required.

Bewertung / *Assessment:*

FGW TR8 / TG8 (Revision 9)	**Bewertung/Assessment**
2.11 Betriebsmittel Prototypen / *Prototype*	
Herstellererklärung zur teilweisen oder vollständigen Konformität zu einer oder mehreren NAR. / *Manufacturer's declaration of partial or full conformity to one or more NAR.*	☒ Berücksichtigt / *Included* (Anhang 1 / *Annex 1*)
Herstellererklärung, dass es sich um eine wesentliche technische Weiterentwicklung bzw. Neuerung handelt. / *Manufacturer's declaration that it is a major technical development or innovation.*	☒ Berücksichtigt / *Included* (Anhang 1 / *Annex 1*)
Aufzeigen von Unterschieden zu ggf. vorhandenen und bereits zertifizierten Betriebsmitteln. / *Identification of differences to any existing and already certified equipment.*	☒ Berücksichtigt / *Included* (Anhang 1 / *Annex 1*)
Herstellererklärung, dass weitere technische Daten den Anforderungen der jeweiligen NAR entsprechen. / *Manufacturer's declaration that further technical data meet the requirements of the respective NAR.*	☒ Berücksichtigt / *Included* (Anhang 1 / *Annex 1*)

3. Prototypenregelung gemäß VDE-AR-N 4110/ *Prototype regulation according to VDE-AR-N 4110*

Nach [N3] muss die Zertifizierungsstelle in der Prototypenbestätigung nachvollziehbar ausweisen, dass der Prototyp grundsätzlich in der Lage ist, die Anforderungen der jeweiligen NAR an die elektrischen Eigenschaften und Funktionen der Betriebsmittel zu erfüllen.

According to [N3], the certification body must clearly state in the prototype confirmation that the prototype is basically able to meet the requirements of the respective NAR for the electrical properties and functions of the equipment.

Die Vorgaben der NAR an den Prüfumfang für die Prototypenbestätigung sind zu berücksichtigen (sofern vorhanden). Im Folgenden wird dazu die Übereinstimmung der elektrischen Eigenschaften der EZE- mit den Anforderungen nach [N1] und [N2] überprüft.

The specifications of the NAR for the scope of testing for the prototype confirmation must be taken into account (if available). In the following, the compliance of the electrical properties of the PGU with the requirements of [N1] and [N2] is checked.

Bewertung / Assessment:

Art der Betriebsmittel ***Type***	EZE / *PGU*		Komponenten / *Components*		
	PV	Speicher / *Storage System*	EZA-Regler / *PGU Controller*	Kompensations-einrichtung / *Compensation equipment*	Schutzein-richtungen / *Protective devices*
	☒	☐	☐	☐	☐
Anmerkung ***Annotation***	Die folgenden Punkte 1), 2) und 4) sind anzuwenden. *The following items 1), 2) and 4) are applied.*		Die folgenden Punkte 1), 2), 3) und 4) sind anzuwenden. *The following items 1), 2), 3) and 4) are applied.*		

Anforderungen an Prototypen gemäß VDE-AR-N 4110 Requirements for Prototypes according to VDE-AR-N 4110		
Nr.	Anforderungen / *Requirements*	Bewertung / *Evaluation*
1)	Der Prototyp weist wesentliche technische Weiterentwicklungen oder Neuerungen auf. / *The prototype shows significant technical developments or innovations.*	☒ Zutreffend/ *Applied*
2)	Der Prototyp ist grundsätzlich in der Lage die Anforderungen dieser VDE-Richtlinie an die elektrischen Eigenschaften zu erfüllen. / *The prototype is basically able to meet the requirements of this VDE guideline for the electrical properties.*	☒ Zutreffend/ *Applied*
3)	Für Komponenten innerhalb der Erzeugungsanlage, für die ein Komponentenzertifikat erforderlich ist, kann die Prototypenregelung entsprechend angewandt werden. *For components within the power generating plant, for which a component certificate is required, the prototype regulation can be applied in analogy.*	☐ Zutreffend/ *Not applicable*
4)	Anforderungen an die Angaben der Datenblätter und darauf basierende Plausibilitätsprüfung (PP) / *Requirements for the information in the data sheets and the plausibility check (PP) based on them*	

	a) Herstellererklärung, dass die Erzeugungseinheit so konstruiert wurde, dass die Anforderungen der VDE erfüllt werden können. / *Manufacturer's declaration that the generating unit was constructed in such a way that the requirements of the VDE can be met.*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 1) / *Fulfilled (Annex 1)* ☐ Entfällt / *Not applicable*	
	b) Schematisches Übersichtsbild der Erzeugungseinheit mit allen wesentlichen Komponenten / *Schematic overview of the generating unit with all essential components*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 2) / *Fulfilled (Annex 2)* ☐ Entfällt / *Not applicable*	
	c) Elektrische Daten (Nenn- und Bemessungsgrößen) / *Electrical data (nominal and rated values)*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 3) / *Fulfilled (Annex 3)* ☐ Entfällt (keine Anforderungen an EZA-Regler)/ *Not applicable for PGU controllers*	
	d) Schutzfunktionen mit Einstellbereichen / *Protection functions with setting ranges* Entkupplungsschutz / *Decoupling protection* Eigenschutz / *Self-protection*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 4) / *Fulfilled (Annex 4)* ☐ Entfällt (keine Anforderungen an EZA-Regler) / *Not applicable for PGU controllers*	
	e) Betriebsbereich der Erzeugungseinheit: / *Operating range of the generating unit* Grenzen im quasistationären Betrieb / *Limits in quasi-steady state operation* Blindleistungsstellbereich / *Reactive power adjustment range* FRT-Grenzkurve (U/t-Diagramm) / *FRT limit curve (U/t diagram)*	☒ Enthalten/ *Included*
	PP: ☒ Erfüllt (Anhang 5) / *Fulfilled (Annex 5)* ☐ Entfällt (keine Anforderungen an EZA-Regler) *Not applicable for PGU controllers*	
	f) Wirkleistungsregelung: / *Active power control* Leistungs-Frequenz-Verhalten; / *Power frequency regulation* Wirkleistungsgradient / *Active power ramping*	☒ Enthalten *Included*
	PP: ☒ *fulfilled: the active power can be regulated by following methods (Annex-6):* *- Power/frequency behavior P = f(f, Pref)* *- Power/Voltage behavior P = f(v)* *- Active power ramping* ☐ Entfällt / *Not applicable*	
	g) Blindleistungsregelung / *Reactive power control regulated by* *- Fixed Q* *- Fixed cos φ* *- Voltage-dependent reactive power Q(U)* *- Active power Dependent reactive power Q(P)*	☒ Enthalten *Included* ☐ Entfällt für EZA-Regler / *Not applicable*
	PP: ☒ Erfüllt (Anhang 7) / *Fulfilled (Annex 7)*: ☐ Entfällt (keine Anforderung an EZA-Regler) / *Not applicable*	
	h) Spannungsstützung bei Netzfehlern durch Blindstromeinspeisung bei dynamischer Netzstützung / *Dynamic reactive current feed-in functionality*	☒ Enthalten *Included*
	PP: ☒ Erfüllt (Anhang 8) / *Fulfilled (Annex 8)* ☐ Entfällt / *Not applicable*	

Votum des Fachauditors / Conclusion

Die TÜV Rheinland Industrie Service GmbH bestätigt, dass es sich bei der genannten EZE nach [N1] und [N2], sowie gemäß [N3], um einen Prototypen handelt, der in der Lage ist die technischen Anforderungen der Normen zu erfüllen. Es wird davon ausgegangen, dass die Anforderungen von [N3] im Rahmen einer Zertifizierung erfüllt werden.

TÜV Rheinland Industrie Service GmbH confirms that the mentioned PGU according to [N1] and [N2], as well as according to [N3], is a prototype that is able to meet the technical requirements of the standards. It is assumed that the requirements of [N3] are met within the framework of a certification.

Die Bewertung ergab keine Beanstandungen.
The evaluation did not result in any objections.

Anhang / Annex
Anhang 1 / Annex 1:
Manufacturer's Declaration

Declaration of VDE-AR-N 4110&4120

SolaX Power Network Technology (Zhe jiang) Co., Ltd.

X3-FTH 80-150K Series

Version: V2.0

Signature: Jason Shen

Date: 11.11.2022

Declaration of VDE-AR-N 4110&4120

1. Company Information

License Holder:	SolaX Power Network Technology (Zhe jiang) Co., Ltd.
Address:	No. 288 Shizhu Road, Tonglu Economic Development Zone, Tonglu City, Zhejiang Province 310000, P.R. China
Product Type:	X3-FTH-80K, X3-FTH-100K, X3-FTH-110K, X3-FTH-120K, X3-FTH-125K, X3-FTH-136K-MV, X3-FTH-150K-MV

2. Product Datasheet: See following page.

The PGU have been designed so that the requirements of VDE-AR-N 4110 and VDE-AR-N 4120 for the power generating unit can be complied with.

The prototype is an essential technical advancement or innovation.

- End -

Anhang 2 / Annex 2:
Electrical Block Diagram

Declaration of VDE-AR-N 4110&4120

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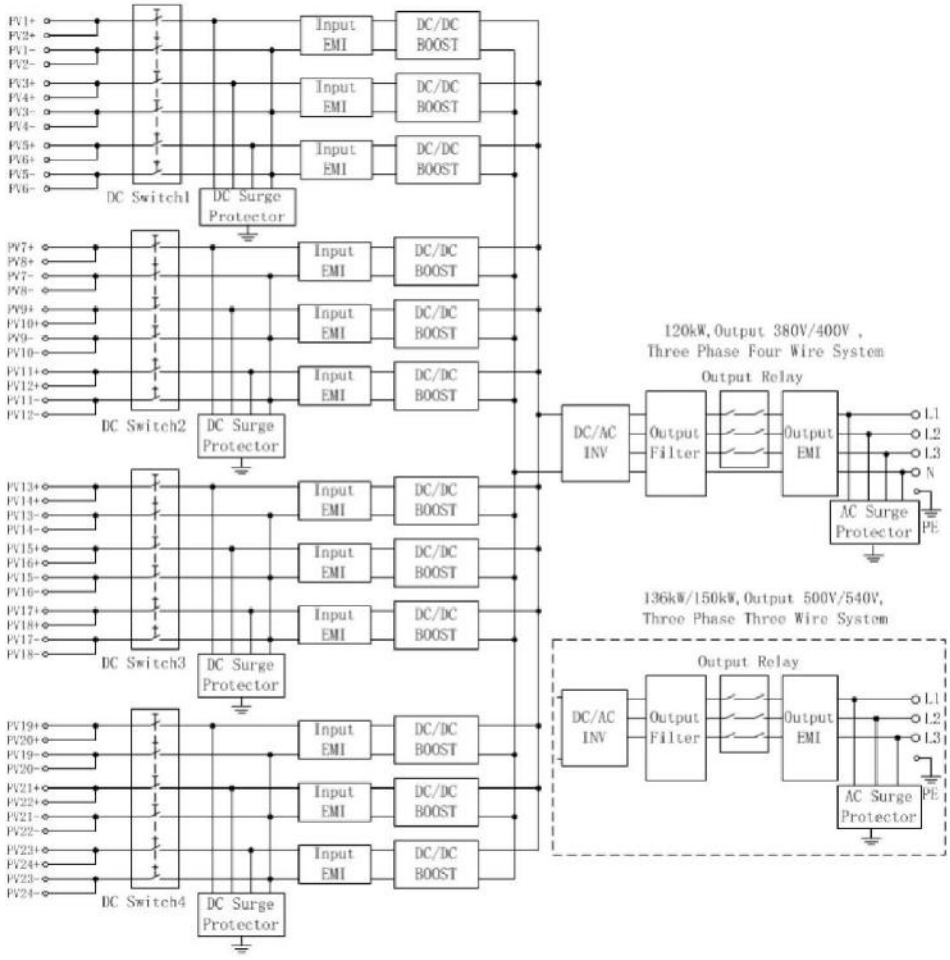
4. Product description:

The PCE under test (EUT) is Grid-connected PV Inverter which utilizes the advanced power electronics conversion components IGBT to convert the variable DC power generated from the photovoltaic (PV) arrays to the stable utility AC power which can be fed into the commercial electrical grid.

The PCE series under test is three-phase grid-connected PV inverter for solar power generation with the rating of 80kW-150kW. All models are identical in hardware and software except for MPPT numbers, electrical ratings and model name.

The block diagrams of products are as below, amount of input terminals may have difference:



X3-FTH-80K, X3-FTH-100K, X3-FTH-110K, X3-FTH-120K, X3-FTH-125K,

X3-FTH-136K-MV, X3-FTH-150K-MV

Anhang 3 / Annex 3:
Electrical Data (nominal and rated)

Declaration of VDE-AR-N 4110&4120

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Product Model:	X3-FTH-80K	X3-FTH-100K	X3-FTH-110K	X3-FTH-120K	X3-FTH-125K
d.c.Max.Input Voltage:	1100 Vd.c				
d.c.Input Voltage Range:	180-1000 Vd.c				
d.c.Max.Input Current:	9*32 A	9*32 A	9*32 A	12*32 A	12*32 A
d.c.Shorted Input Current:	9*46 A	9*46 A	9*46 A	12*46 A	12*46 A
a.c.Rated Output Voltage:	3/N/PE 400V	3/N/PE 400V	3/N/PE 400V	3/N/PE 400V	3/N/PE 400V
a.c.Rated Output Frequency:	50/60 Hz				
a.c.Max.Output Current:	127.6 A	159.5 A	175.4 A	191.3 A	191.3 A
a.c.Rated Output Power:	80 kW	100 kW	110 kW	120 kW	125 kW
Max.Apparent Power:	88 kVA	110 kVA	121 kVA	132 kVA	132 kVA
Adjustable Power Factor Range:	0.8(lagging)~0.8(leading)				
Enclosure:	IP66				
Temperature Range:	-25℃ ~ +60℃				
Voltage measure accuracy	± 1% Un				
Frequency measure accuracy	± 0.05Hz				
Firmware:	XFORTH V005.00				
Protective Class:	I				

Declaration of VDE-AR-N 4110&4120

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Product Model:	X3-FTH-136K-MV	X3-FTH-150K-MV
d.c.Max.Input Voltage:	1100 Vd.c	
d.c.Input Voltage Range:	180-1000 Vd.c	
d.c.Max.Input Current:	12*32 A	12*32 A
d.c.Shorted Input Current:	12*46 A	12*46 A
a.c.Rated Output Voltage:	3/PE 540V	3/PE 540V
a.c.Rated Output Frequency:	50/60 Hz	
a.c.Max.Output Current:	160.0 A	176.5 A
a.c.Rated Output Power:	136 kW	150 kW
Max.Apparent Power:	149.6 kVA	165 kVA
Adjustable Power Factor Range:	0.8(lagging)~0.8(leading)	
Enclosure:	IP66	
Temperature Range:	-25℃ ~ +60℃	
Voltage measure accuracy	± 1% Un	
Frequency measure accuracy	± 0.05Hz	
Firmware:	XFORTH V005.00	
Protective Class:	I	

Declaration of VDE-AR-N 4110&4120

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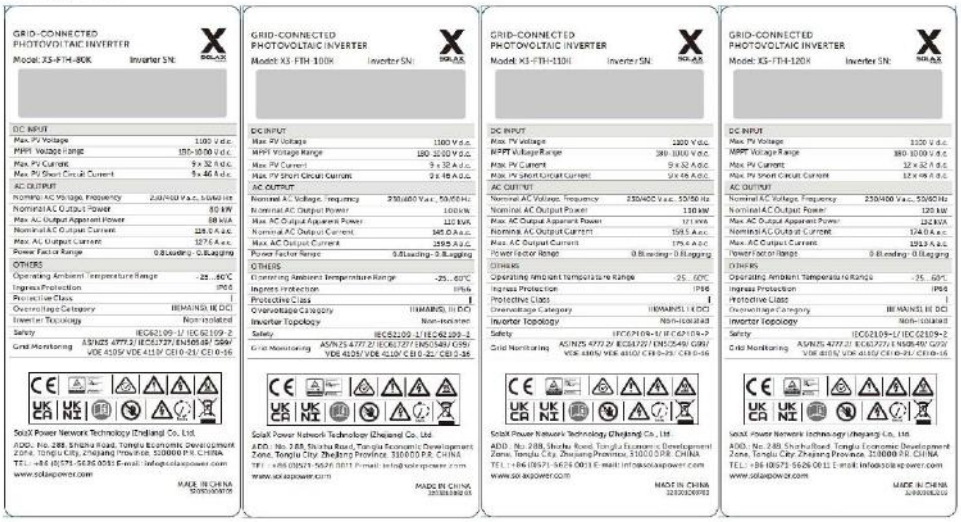
3. Rating Label:



Declaration of VDE-AR-N 4110&4120

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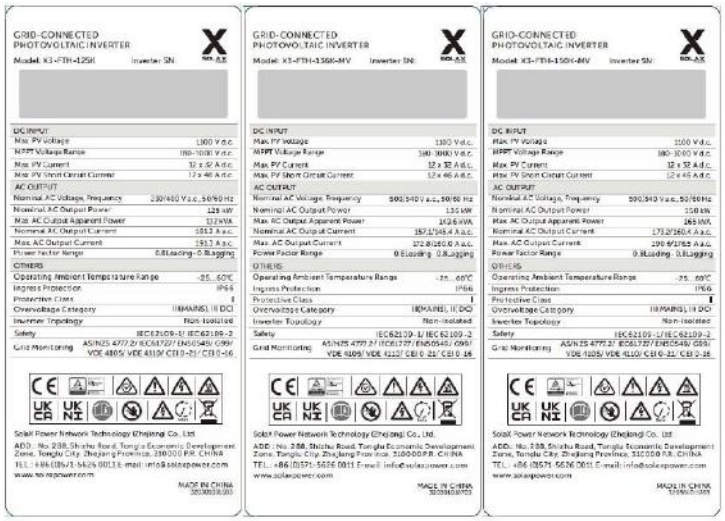

Anhang 4 / Annex 4:
Protection function with setting ranges

Declaration of VDE-AR-N 4110&4120

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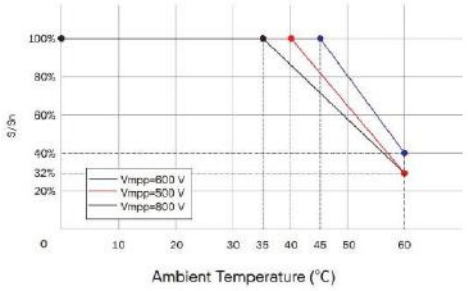
9. Active power dependent on ambient temperature

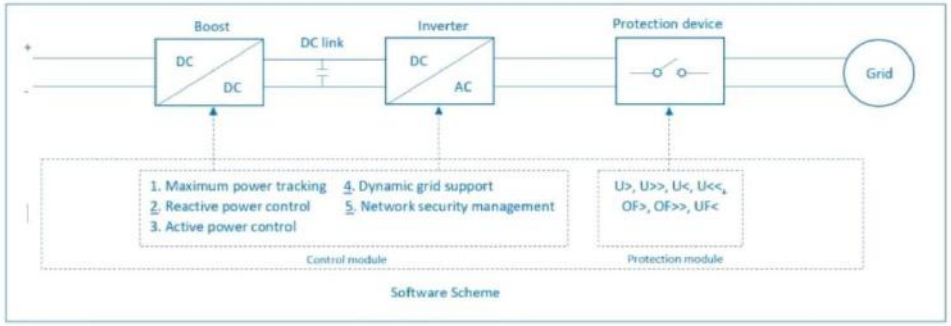
Following Power-temp curve applies on all series models:

- Relationship between ambient temperature and output power



10. Interface protection function

Interface protection settings:			
Parameter	Setting range	Setting step	Default value
OV1 protection value *OV-G-V1*	1.00Un...1.30Un	0.001Un	1.10Un
OV1 protection time *OVGV1-T*	0.01s...180s	0.01s	100ms
OV2 protection value *OV-G-V2*	1.00Un...1.30Un	0.001Un	1.25Un
OV2 protection time *OVGV2-T*	10ms...100ms	0.01s	100ms
UV1 protection value *UN-G-V1*	0.10Un...1.00Un	0.001Un	0.80Un
UV1 protection time *UNGV1-T*	0.01s ...2.4s	0.01s	1.0s
UV2 protection value *UN-G-V2*	0.10Un...1.00Un	0.001Un	0.45Un
UV2 protection time *UNGV2-T*	10ms ...800ms	0.01s	300ms
OF1 protection value *OV-G-F1*	50.0Hz...55.0Hz	0.01Hz	51.5Hz
OF1 protection time *OVGF1T*	0.01s ...5s	0.01s	100ms
OF2 protection value *OV-G-F2*	50.0Hz...55.0Hz	0.01Hz	52.5Hz
OF2 protection time *OVGF2T*	10ms...100ms	0.01s	100ms
UF1 protection value *UN-G-F1*	45.0Hz...50.0Hz	0.01Hz	47.5Hz
UF1 protection time *UNGF1T*	10ms...100ms	0.01s	100ms



All the settings values are readable through PC or directly on display.

The self-check function of protection device is integrated in unit and could be started by PC without any wiring change. When self-check function started, the program would change the voltage sampling value to trip the protection settings. It's detected by unit if the protection relay works normally.

The integrated protection functions are implemented in separate software modules and they operate independent from control functions as the software block diagram below:

The auxiliary power supply of protection device be supply from dc side, as a network independent auxiliary power can supply to the protection device over 5s. The protection device would be tripped immediately as long as the auxiliary power supply failed.

11. Reconnection conditions

After a power generating unit was disconnected from the network by opening the coupler circuit-breaker(galvanic isolation) at the power generating unit due to the tripping of decoupling protection equipment(overfrequency, underfrequency, voltage reduction, voltage rise), automatic connection or reconnection of the power generating units is permitted only if the voltage at the network connection point is at least 95 % Uc and if the frequency is between 49,9 Hz and 50,1 Hz.

The gradient of power recovery could be set between 1%Pn/min – 100%Pn/min.

Automatic reconnection of the power generating units may only be made after the mains voltage and frequency have been stable within the aforementioned voltage and frequency limits for a settable period of time. This time period shall be adjustable from undelayed operation up to 10 min. Unless otherwise specified by the network operator, a default value of 5 min shall be set.

Declaration of VDE-AR-N 4110&4120

12. Interface Switch Information

Mfg.	Type	Parameter
Songchuan	511ZP-1AD-F-C M06	200A, - 40~70°C
Hongfa	HF167F-200	200A, - 40~85°C

the interface switch complied with:

- Three-pole galvanic separation.

- The switch is designed as specified by the manufacturer. The switching capacity of the coupling switch may sustain the max. output current of inverter

- The coupling switch is designed to be triggered without delay.

- The sum of time elements of the protection and switching equipment does not exceed 100 ms.

Anhang 5 / Annex 5:
Operating ranges for the PGU
FRT limit curve (U/t diagram)

Declaration of VDE-AR-N 4110&4120

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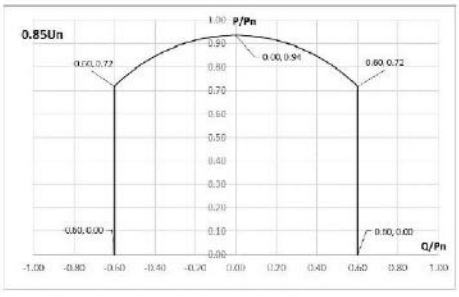
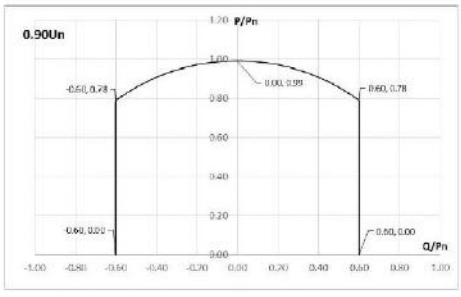
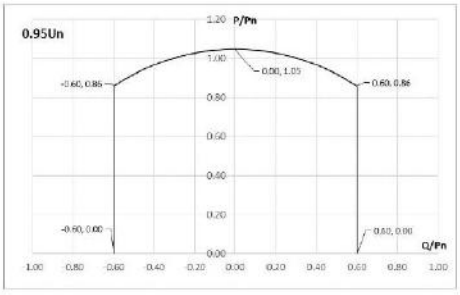
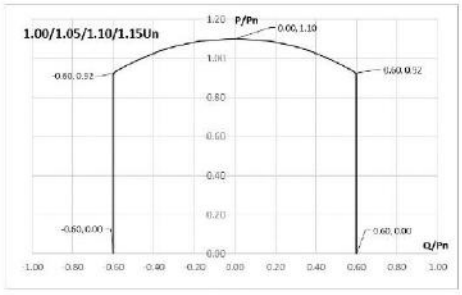
5. PQ diagram:

X3-FTH-80K								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.600	0.600
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.600	0.600
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	-0.458	-0.458
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.458	0.458
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000



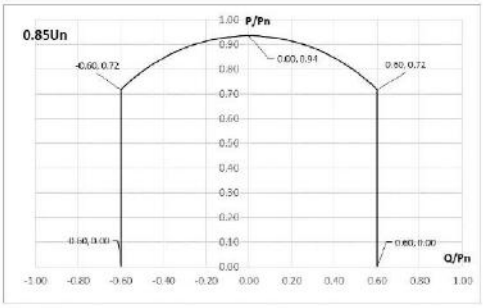


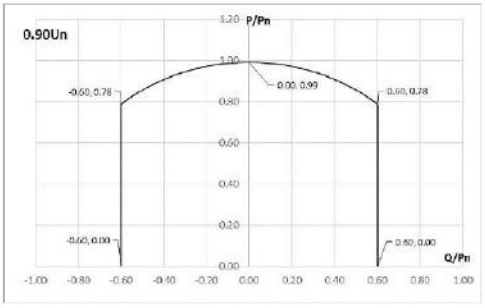


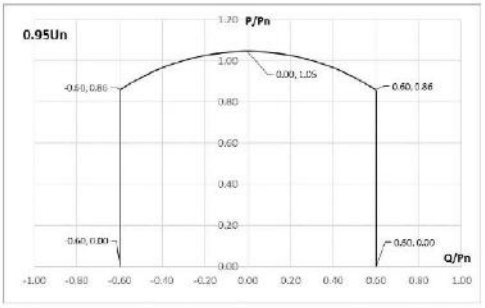


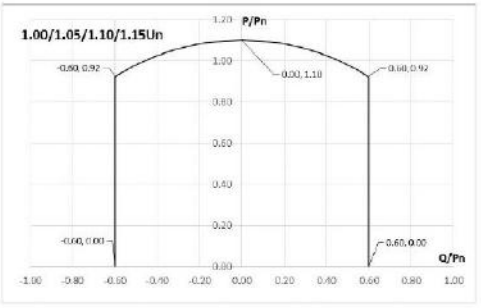
Declaration of VDE-AR-N 4110&4120

X3-FTH-100K								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.600	0.600
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.600	0.600
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	-0.458	-0.458
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.458	0.458
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000



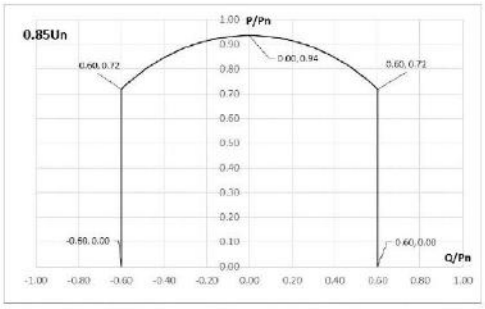


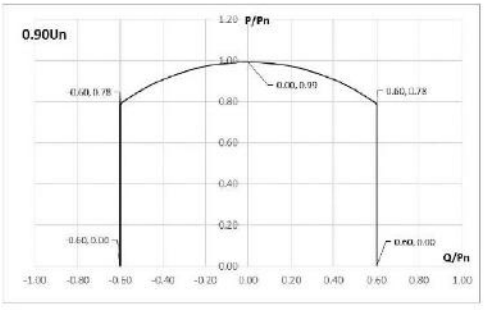


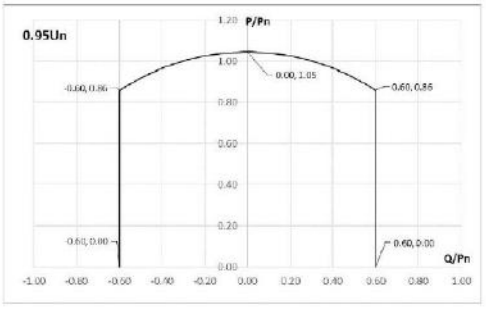


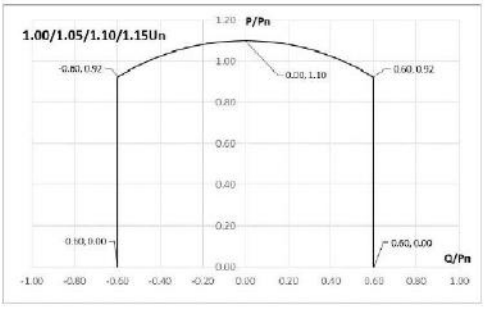
Declaration of VDE-AR-N 4110&4120

X3-FTH-110K								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.600	0.600
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.600	0.600
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	-0.458	-0.458
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.458	0.458
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000



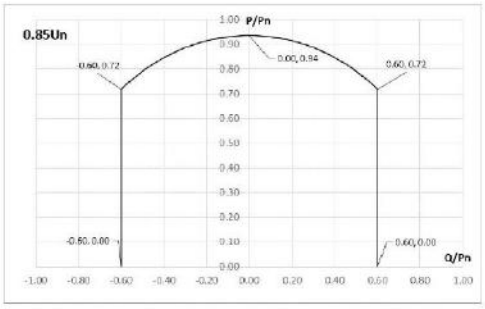


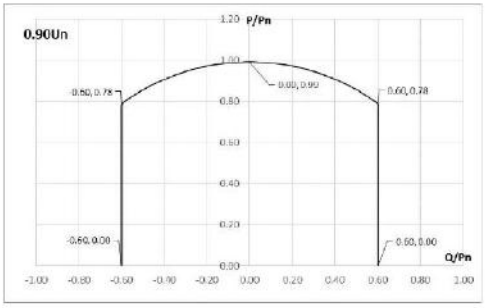


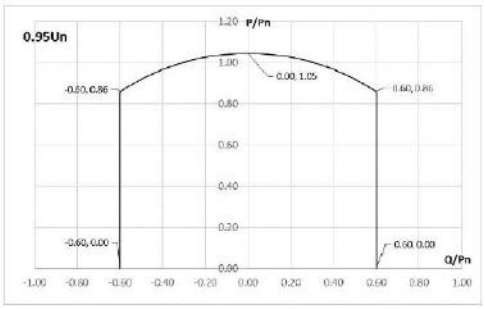


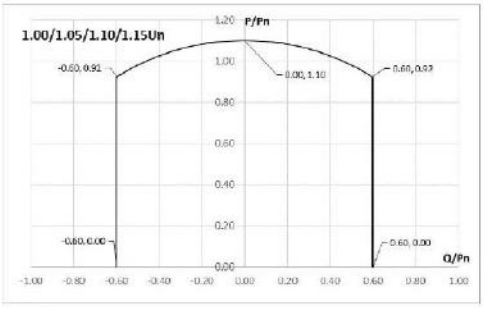
Declaration of VDE-AR-N 4110&4120

X3-FTH-120K								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.600	0.600
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.600	0.600
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	-0.458	-0.458
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.458	0.458
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000



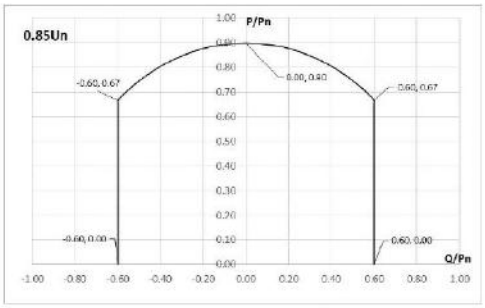


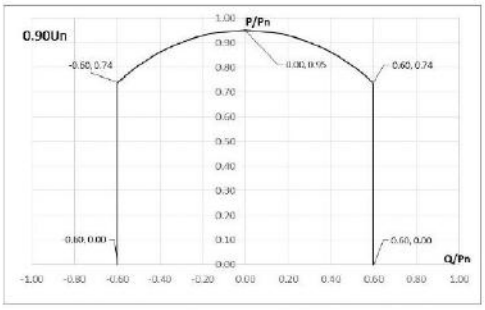


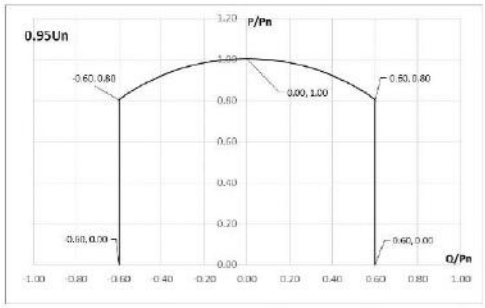


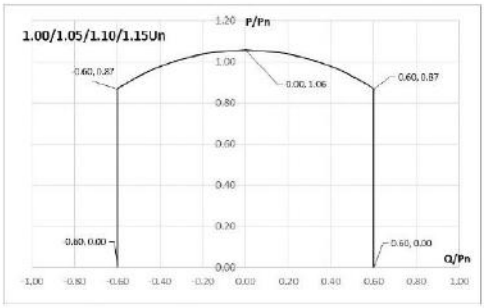
Declaration of VDE-AR-N 4110&4120

X3-FTH-125K								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.7	Underexcited	-0.562	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.562	0.600	0.600	0.600	0.600	0.600	0.600
0.8	Underexcited	-0.407	-0.513	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.407	0.513	0.600	0.600	0.600	0.600	0.600
0.9	Underexcited	0.000	-0.305	-0.443	-0.552	-0.552	-0.552	-0.552
	Overexcited	0.000	0.305	0.443	0.552	0.552	0.552	0.552
1.0	Underexcited	0.000	0.000	-0.080	-0.339	-0.339	-0.339	-0.339
	Overexcited	0.000	0.000	0.080	0.339	0.339	0.339	0.339
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000



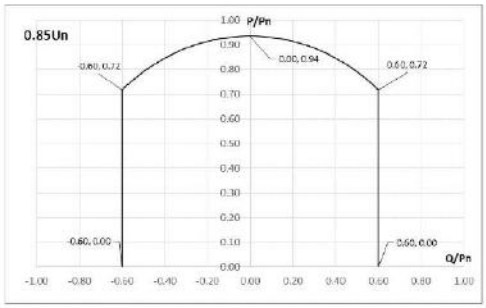


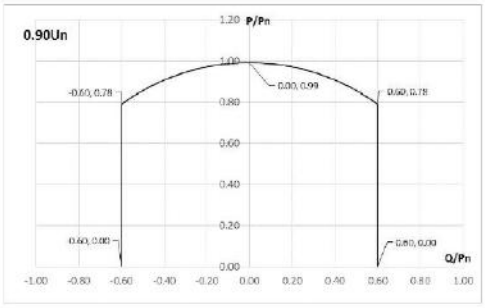


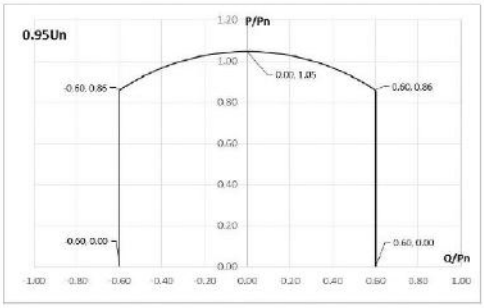


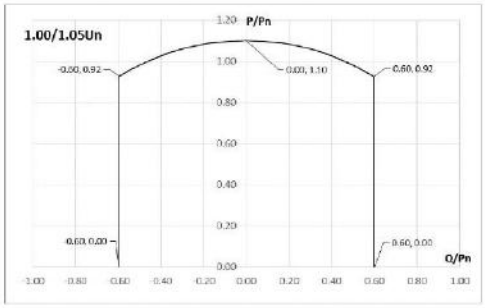
Declaration of VDE-AR-N 4110&4120

X3-FTH-136K-MV								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.580
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.580
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.536
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.536
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.466
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.466
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.356
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.356
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.130
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.130
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.537	0.000
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.537	0.000
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.372	0.000
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.372	0.000
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	0.000	0.000
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.000	0.000
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	0.000	0.000
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.000	0.000
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000

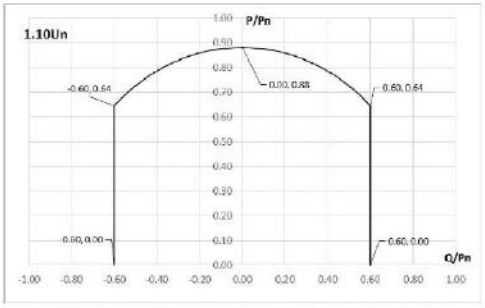


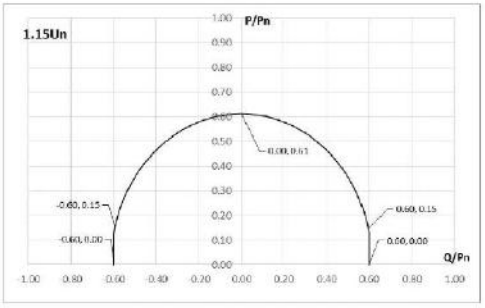






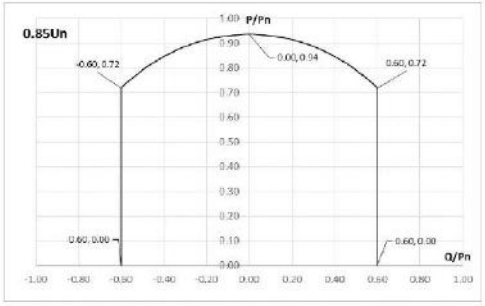
Declaration of VDE-AR-N 4110&4120

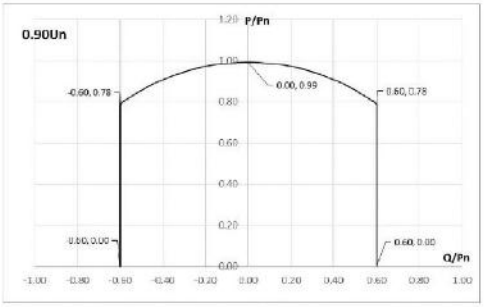


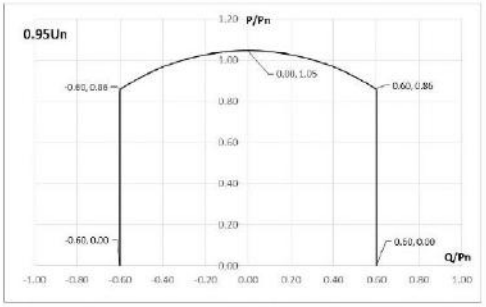


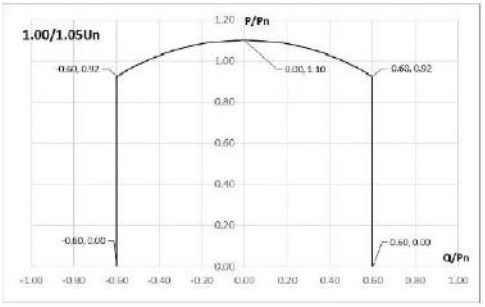
Declaration of VDE-AR-N 4110&4120

X3-FTH-150K-MV								
P [p.u.]	Direction	Qmax [p.u.]						
		85 % U_N	90 % U_N	95 % U_N	100 % U_N	105 % U_N	110 % U_N	115 % U_N
0	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.1	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.600
0.2	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.580
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.580
0.3	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.536
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.536
0.4	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.466
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.466
0.5	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.356
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.356
0.6	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.600	-0.130
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.600	0.130
0.7	Underexcited	-0.600	-0.600	-0.600	-0.600	-0.600	-0.537	0.000
	Overexcited	0.600	0.600	0.600	0.600	0.600	0.537	0.000
0.8	Underexcited	-0.485	-0.584	-0.600	-0.600	-0.600	-0.372	0.000
	Overexcited	0.485	0.584	0.600	0.600	0.600	0.372	0.000
0.9	Underexcited	-0.255	-0.414	-0.532	-0.600	-0.600	0.000	0.000
	Overexcited	0.255	0.414	0.532	0.600	0.600	0.000	0.000
1.0	Underexcited	0.000	0.000	-0.305	-0.458	-0.458	0.000	0.000
	Overexcited	0.000	0.000	0.305	0.458	0.458	0.000	0.000
1.1	Underexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Overexcited	0.000	0.000	0.000	0.000	0.000	0.000	0.000

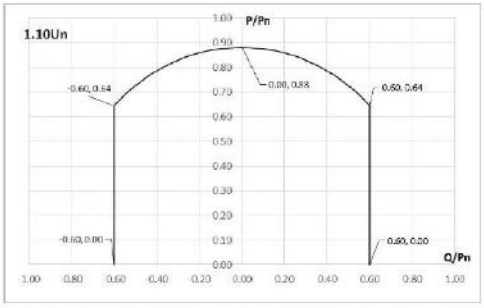


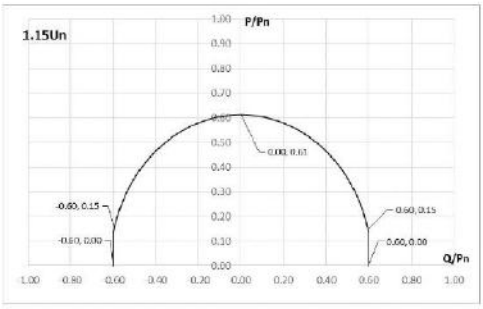






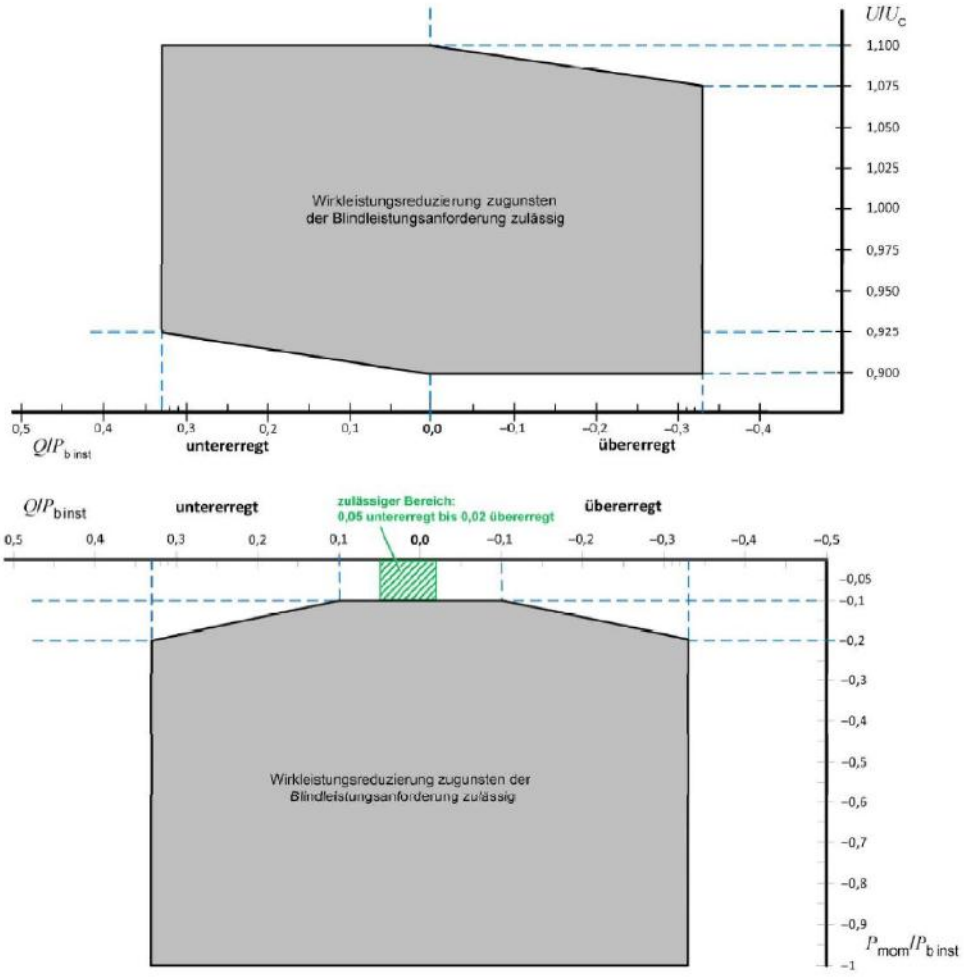
Declaration of VDE-AR-N 4110&4120





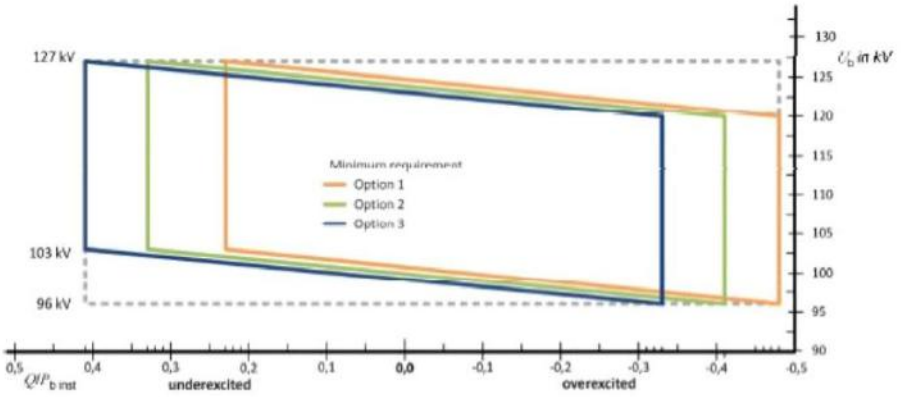
Declaration of VDE-AR-N 4110&4120

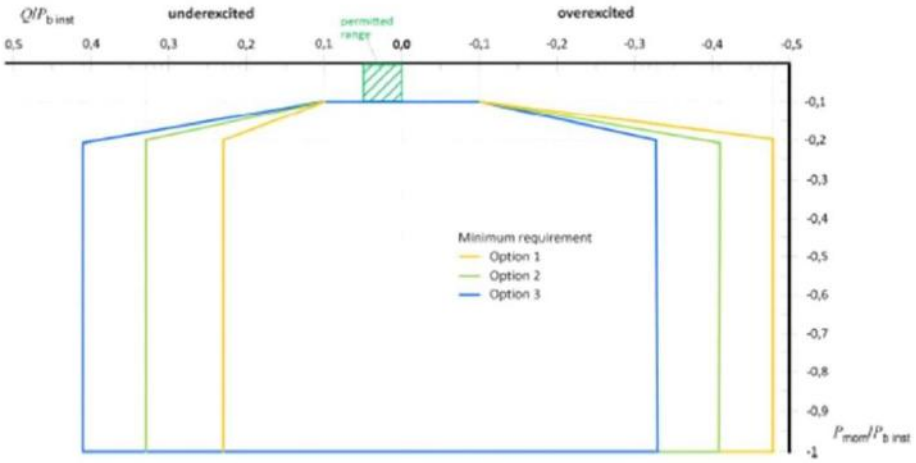
Every set point value specified by the grid operator can be achieved within the required reactive power range from VDE-AR-N 4110.



Declaration of VDE-AR-N 4110&4120

Every set point value specified by the grid operator can be achieved within the required reactive power range from VDE-AR-N 4120.



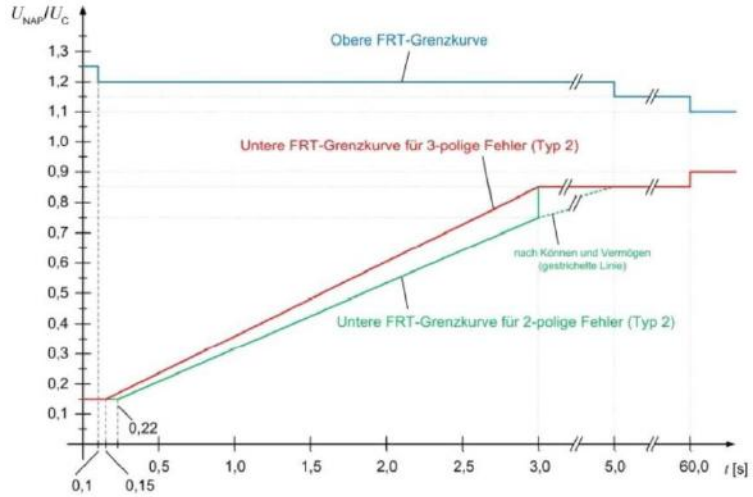


Declaration of VDE-AR-N 4110&4120

13. Dynamic Grid Support

The inverter is able to keep connecting on the grid in case grid voltage change within the limit curve below, even the step change of voltage exceeded 15%Un.

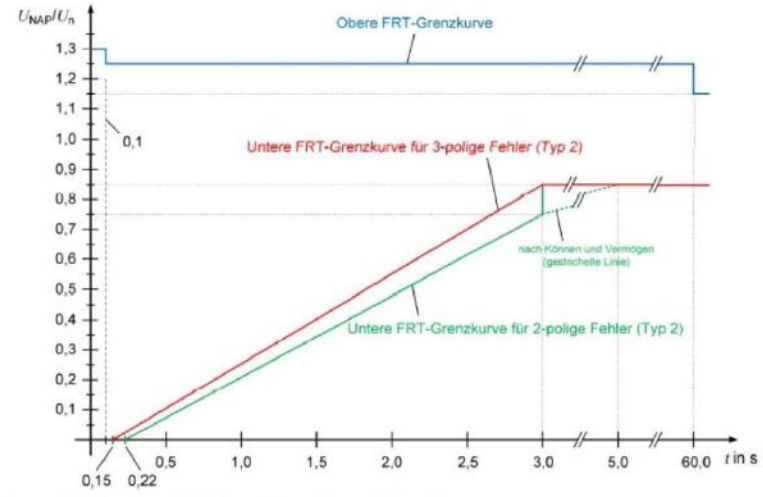
VDE-AR-N 4110:2018-11:



Legende

U_{NAP} Effektivwert der aktuellen Spannung am Netzanschlusspunkt

VDE-AR-N 4120:2018-11:



U_{NAP} = Effektivwert der aktuellen Spannung am Netzanschlusspunkt

Declaration of VDE-AR-N 4110&4120

During the voltage fault, the inverter may:

a) cease feeding any current to grid or
b) feed the reactive current of both positive and negative sequence components according to the ΔU-ΔI relationship below:

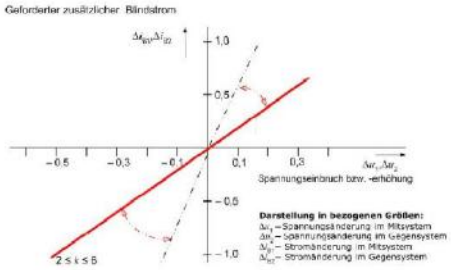


Bild 15 – Prinzip der Spannungsstützung bei Netzfehlern

Response the reactive current fulfill:
a) Anschwingzeit: $T_{an\_90\ \%} \leq 30$ ms;
b) Einschwingzeit: $T_{ein\ \Delta x} \leq 60$ ms.

Dynamic network support			
Parameter	Setting range	Setting step	Default value
Operation Mode	Full support / Zero current	--	Full support
K factor *VRT_K1, VRT_K2*	2 …6	0.5	4
Entry threshold *StaticVL, StaticVH*	Upper bond: 0.8…1.0Un *StaticVH* Lower bond: 1.0…1.2Un *StaticVL*	0.01Un	Upper bond: 1.1Un *StaticVH* Lower bond: 0.9Un *StaticVL*

Anhang 6 / Annex 6:
Active power adjustment

Declaration of VDE-AR-N 4110&4120

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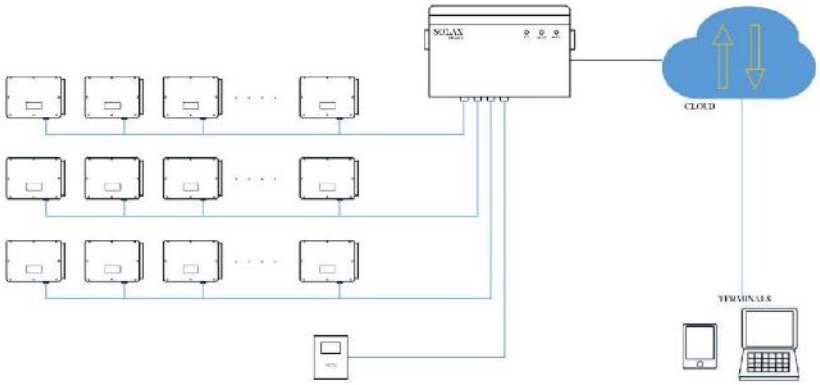
7. Network security management

Network security management			
Parameter	Setting range	Setting step	Default value
Active power	0...1.0Pn	0.01Pn	1.0Pn
Power Gradient	0.33%Pn/s...0.66%Pn/s	0.01%Pn/s	0.5%Pn/s

Interface: RS485

There is single interface for network security management integrated in each unit and only one command from network or third party can be responded a time.



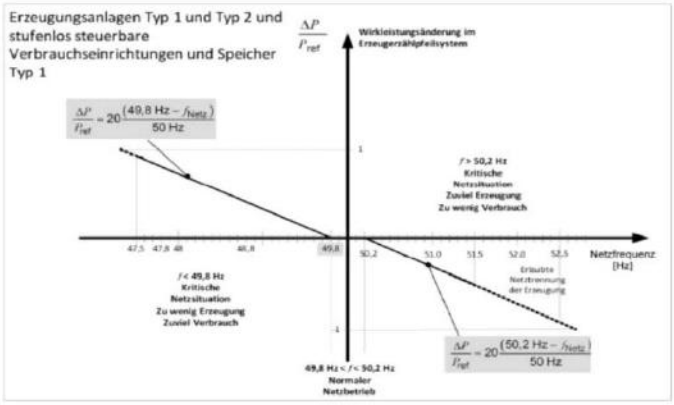
8. Active power output dependent on grid frequency

RoCoF complied with:

±2.0Hz/s for a moving average window 0.5s or

±1.5Hz/s for a moving average window 1s or

±1.25Hz/s for a moving average window 2s P(f) curve:



Over frequency curve start point: 50.2Hz – 50.5Hz adjustable Over frequency curve droop: 2% - 12% adjustable.

Under frequency curve start point: 49.5Hz – 49.8Hz adjustable Under frequency curve droop: 2% - 12% adjustable

While frequency step or shift exceeded the dead-band of P(f) curve, the unit output decrease or increase according to the droop of curve. There is no power change when frequency located within the dead-band

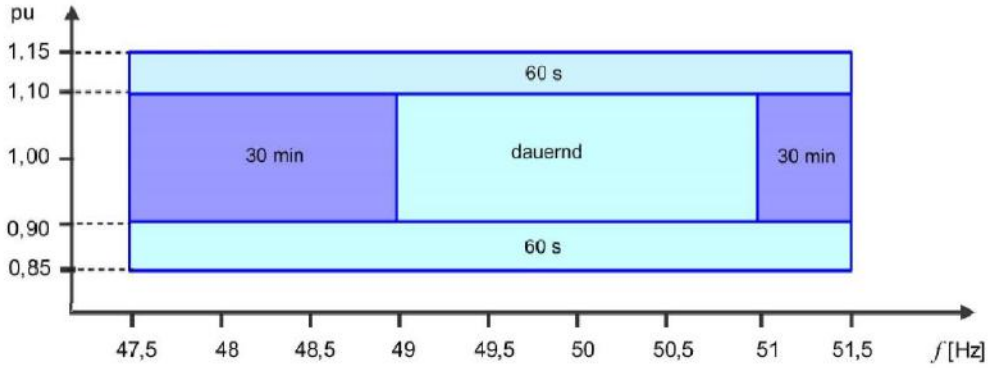
(50±200mHz default). In the case of frequency above 51.5Hz the unit is able to remain connected to grid for another 5s without any power increase.

Even if the mains frequency has regained the tolerance band of 50,0 Hz ± 200 mHz after the frequency deviation, a critical network condition shall still be assumed. The transition from "critical network condition" to "normal operation" is time-limited by a maximum change of the set-point active power, starting from Pmom. This set-point active power change (except for the supply of control energy) shall be limited to a maximum gradient of 10 % Pb inst/min. Only when the mains frequency has been within the tolerance band of 50,0 Hz ± 200 mHz for an uninterrupted period of 10 min, the normal network operation is considered to be restored and this requirement is no longer valid.

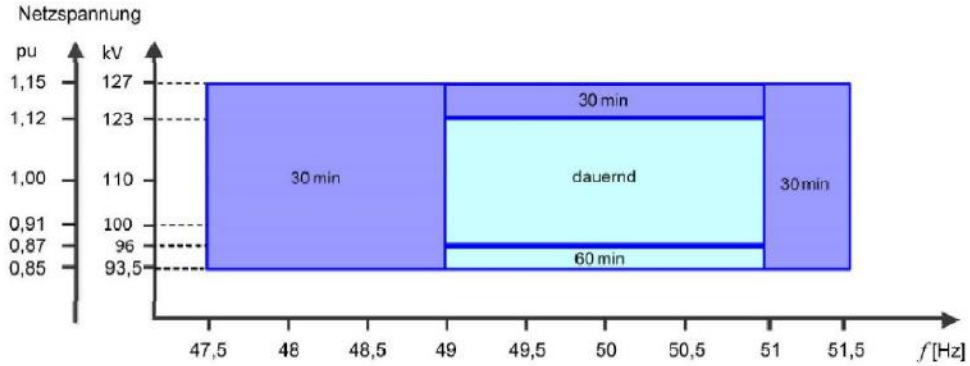
The following requirements complied:

1) Initial time delay Tv< 2 s
2) Accuracy of frequency measurement < 10 mHz
3) Accuracy of fast frequency measurement < 50 mHz
4) Sample time < 200 ms

VDE-AR-N 4110:2018-11:



VDE-AR-N 4120:2018-11:

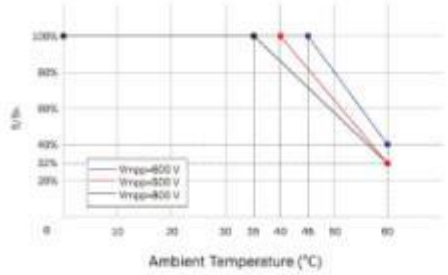


Declaration of VDE-AR-N 4110&4120

9. Active power dependent on ambient temperature

Following Power-temp curve applies on all series models:

- Relationship between ambient temperature and output power



Anhang 7 / Annex 7:
Reactive power control

6. Methods for reactive power control

The reactive power is always prioritised over active power.

The P-Q relation in normal operation always follow the equation:

S=min(U*I, min(Smax, U*Imax))

P=sqrt(S^2-Q^2)

a. Reactive power-voltage character curve Q(U)

Reactive power-voltage character curve Q(U):			
Parameter	Setting range	Setting step	Default value
Reactive power node *(Q1-Q4)*	Q1: 0…0.6Pn Q2: -0.6Pn...0.6Pn Q3: -0.6Pn...0.6Pn Q4: -0.6Pn...0	0.01Pn	Q1: 0.44Pn Q2: 0 Q3: 0 Q4: -0.44Pn
Voltage node *(Voltage1-Voltage4)*	Voltage1: 0.93Un…1.00Un Voltage2: 0.95Un…1.00Un Voltage3: 1.00Un…1.05Un Voltage4: 1.00Un…1.07Un	0.01Un	Voltage1: 0.96Un Voltage2: 1.00Un Voltage3: 1.00Un Voltage4: 1.04Un
Settling time *3Tau*	6s…60s	1s	10s

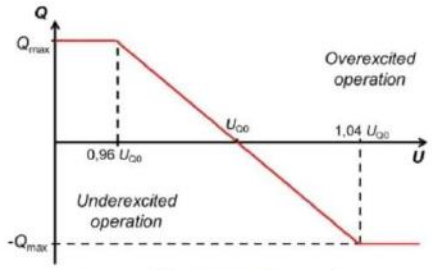


Fig. 4–166: Q(U) characteristic for use in the test

b. Character curve Q(P)

Character curve Q(P)			
Parameter	Setting range	Setting step	Default value
Reactive Power Node (Q1-Q5)	Q1: -0.6Pn...0.6Pn Q2: -0.6Pn...0.6Pn Q3: -0.6Pn...0.6Pn Q4: -0.6Pn...0.6Pn Q5: -0.6Pn...0.6Pn	0.01Pn	Q1: 0 Q2: 0 Q3: -0.05Pn Q4: -0.33Pn Q5: -0.33Pn
Active Power Node (P1-P5)	P1: 0...1.0Pn P2: 0...1.0Pn P3: 0...1.0Pn P4: 0...1.0Pn P5: 0...1.0Pn	0.1Pn	P1: 0 P2: 0.5Pn P3: 0.6Pn P4: 0.9Pn P5: 1.0Pn
Settling time 3Tau	6s…60s	1s	10s

Declaration of VDE-AR-N 4110&4120

Curve setting in test:

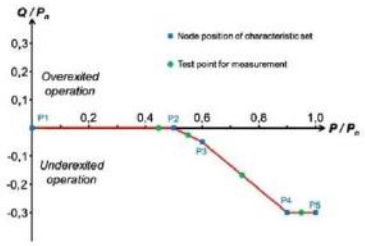


Fig. 4–177: Q(P) characteristic for test

c. Fixed Q

Fixed Q			
Parameter	Setting range	Setting step	Default value
Reactive power Q *React. Power*	-0.6Pn...0.6Pn	0.01Pn	Q=0
Reactive power Q in com loss condition	--	--	last set-point received
Settling time *3Tau*	6s...60s	1s	10s

If communication with plant controller or network operator interrupted over 1min, the reactive power maintain the last set-point received.

d. Fixed cosφ

Fixed cosφ			
Parameter	Setting range	Setting step	Default value
Displacement factor *Power Factor*	0.80ue...0.80oe	0.005	1.00
Displacement factor in com loss condition	--	--	last set-point received
Settling time *3Tau*	6s...60s	1s	10s

If communication with plant controller or network operator interrupted over 1min, the reactive power maintain the last set-point received.

Anhang 8 / Annex 8:
Dynamic reactive current feed-in functionality

Declaration of VDE-AR-N 4110&4120

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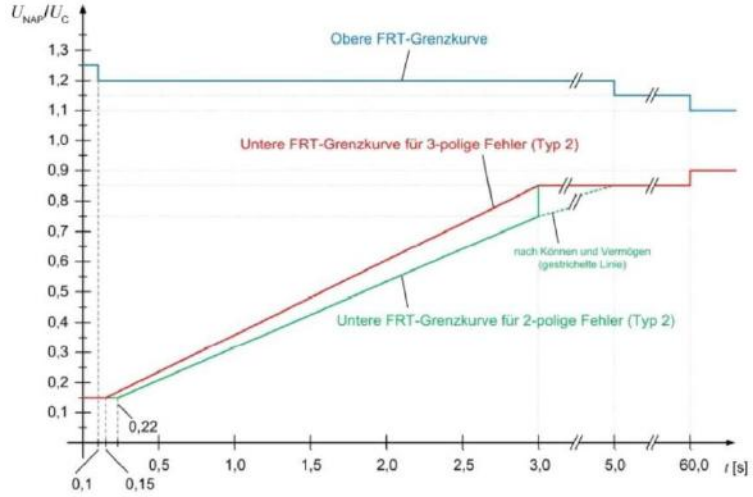
13. Dynamic Grid Support

The inverter is able to keep connecting on the grid in case grid voltage change within the limit curve below, even the step change of voltage exceeded 15%Un.

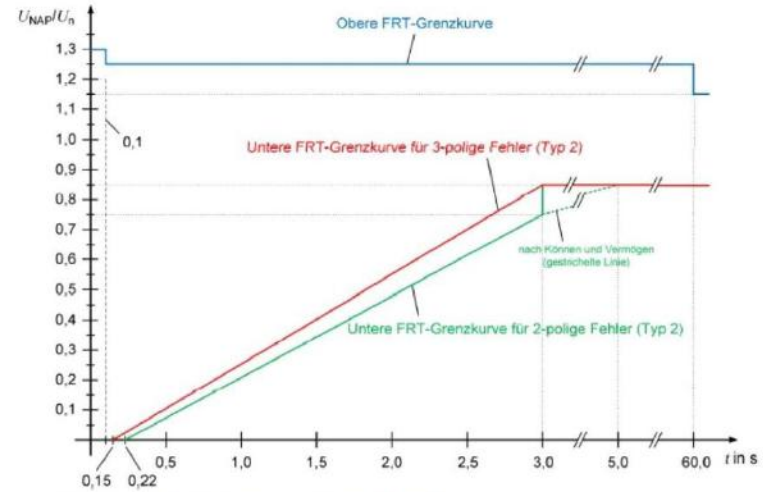
VDE-AR-N 4110:2018-11:



Legende

U_{NAP} Effektivwert der aktuellen Spannung am Netzanschlusspunkt

VDE-AR-N 4120:2018-11:



U_{NAP} = Effektivwert der aktuellen Spannung am Netzanschlusspunkt

Declaration of VDE-AR-N 4110&4120

During the voltage fault, the inverter may:

a) cease feeding any current to grid or
b) feed the reactive current of both positive and negative sequence components according to the ΔU-ΔI relationship below:

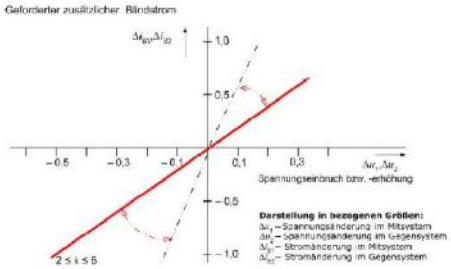


Bild 15 – Prinzip der Spannungsstützung bei Netzfehlern

Response the reactive current fulfill:
a) Anschwingzeit: $T_{an\_90\ \%} \leq 30$ ms;
b) Einschwingzeit: $T_{ein\ \Delta x} \leq 60$ ms.

Dynamic network support			
Parameter	Setting range	Setting step	Default value
Operation Mode	Full support / Zero current	--	Full support
K factor *VRT_K1, VRT_K2*	2 …6	0.5	4
Entry threshold *StaticVL, StaticVH*	Upper bond: 0.8…1.0Un *StaticVH* Lower bond: 1.0…1.2Un *StaticVL*	0.01Un	Upper bond: 1.1Un *StaticVH* Lower bond: 0.9Un *StaticVL*

Anhang 9 / Annex 9:
Configuration Summary

Declaration of VDE-AR-N 4110&4120

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SOLAX

14. Configuration summary

Interface protection settings:			
Parameter	Setting range	Setting step	Default value
OV1 protection value *OV-G-V1*	1.00Un…1.30Un	0.001Un	1.10Un
OV1 protection time *OVGV1-T*	0.01s…180s	0.01s	100ms
OV2 protection value *OV-G-V2*	1.00Un…1.30Un	0.001Un	1.25Un
OV2 protection time *OVGV2-T*	10ms…100ms	0.01s	100ms
UV1 protection value *UN-G-V1*	0.10Un…1.00Un	0.001Un	0.80Un
UV1 protection time *UNGV1-T*	0.01s…2.4s	0.01s	1.0s
UV2 protection value *UN-G-V2*	0.10Un…1.00Un	0.001Un	0.45Un
UV2 protection time *UNGV2-T*	10ms…800ms	0.01s	300ms
OF1 protection value *OV-G-F1*	50.0Hz…55.0Hz	0.01Hz	51.5Hz
OF1 protection time *OVGF1T*	0.01s…5s	0.01s	100ms
OF2 protection value *OV-G-F2*	50.0Hz…55.0Hz	0.01Hz	52.5Hz
OF2 protection time *OVGF2T*	10ms…100ms	0.01s	100ms
UF1 protection value *UN-G-F1*	45.0Hz…50.0Hz	0.01Hz	47.5Hz
UF1 protection time *UNGF1T*	10ms…100ms	0.01s	100ms
Self-protection settings:			
Parameter	Setting range	Setting step	Default value
OV protection value	--	--	1.40Un
OV protection time	--	--	50ms
Connection condition settings:			
Parameter	Setting range	Setting step	Default value
Voltage range *Start-VH, Start-VL*	--	--	90%Un…110%Un
Frequency range *Start-FH, Start-FL*	--	--	47.5Hz…50.2Hz
Delay time *Startup-T*	--	--	60s
Power Gradient *Ramp-up-EN*	0.33%Pn/s...0.66%Pn/s	0.01%Pn/s	0.5%Pn/s
Reconnection condition settings:			
Parameter	Setting range	Setting step	Default value
Voltage range *Restore-VH, Restore-VL*	--	--	≥ 95%Un
Frequency range *Restore-FH, Restore-FL*	--	--	49.9Hz…50.1Hz
Delay time *Restore-T*	0...30 mins	1s	10 mins
Power Gradient *Reconnect-EN*	0.33%Pn/s...0.66%Pn/s	0.01%Pn/s	0.5%Pn/s
Reactive power-voltage character curve Q(U):			
Parameter	Setting range	Setting step	Default value

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Reactive power node *(Q1-Q4)*	Q1: 0…0.6Pn Q2: -0.6Pn...0.6Pn Q3: -0.6Pn...0.6Pn Q4: -0.6Pn...0	0.01Pn	Q1: 0.44Pn Q2: 0 Q3: 0 Q4: -0.44Pn
Voltage node *(Voltage1-Voltage4)*	Voltage1: 0.93Un…1.00Un Voltage2: 0.95Un…1.00Un Voltage3: 1.00Un…1.05Un Voltage4: 1.00Un…1.07Un	0.01Un	Voltage1: 0.96Un Voltage2: 1.00Un Voltage3: 1.00Un Voltage4: 1.04Un
Settling time *3Tau*	6s…60s	1s	10s
Character curve Q(P)			
Parameter	Setting range	Setting step	Default value
Reactive Power Node *(Q1-Q5)*	Q1: -0.6Pn...0.6Pn Q2: -0.6Pn...0.6Pn Q3: -0.6Pn...0.6Pn Q4: -0.6Pn...0.6Pn Q5: -0.6Pn...0.6Pn	0.01Pn	Q1: 0 Q2: 0 Q3: -0.05Pn Q4: -0.33Pn Q5: -0.33Pn
Active Power Node *(P1-P5)*	P1: 0...1.0Pn P2: 0...1.0Pn P3: 0...1.0Pn P4: 0...1.0Pn P5: 0...1.0Pn	0.1Pn	P1: 0 P2: 0.5Pn P3: 0.6Pn P4: 0.9Pn P5: 1.0Pn
Settling time *3Tau*	6s…60s	1s	10s
Fixed Q			
Parameter	Setting range	Setting step	Default value
Reactive power Q *React. Power*	-0.6Pn…0.6Pn	0.01Pn	Q=0
Reactive power Q in com loss condition	--	--	last set-point received
Settling time *3Tau*	6s…60s	1s	10s
Fixed cosφ			
Parameter	Setting range	Setting step	Default value
Displacement factor *Power Factor*	0.80ue…0.80oe	0.005	1.00
Displacement factor in com loss condition	--	--	last set-point received
Settling time *3Tau*	6s…60s	1s	10s
Network security management			
Parameter	Setting range	Setting step	Default value
Active power	0...1.0Pn	0.01Pn	1.0Pn
Power Gradient	0.33%Pn/s...0.66%Pn/s	0.01%Pn/s	0.5%Pn/s
Active power output dependent on grid frequency			
Parameter	Setting range	Setting step	Default value
OF threshold *OV-F-Start*	50.2Hz…50.5Hz	0.01Hz	50.2Hz
OF droop *Gradient*	2%...12%	1%	5%
UF threshold *FDStart*	49.5Hz...49.8Hz	0.01Hz	49.8Hz
UF droop *FDdroop*	2%...12%	1%	5%

Dynamic network support			
Parameter	Setting range	Setting step	Default value
Operation Mode	Full support / Zero current	--	Full support
K factor *VRT_K1, VRT_K2*	2 ...6	0.5	4
Entry threshold *StaticVL, StaticVH*	Upper bond: 0.8...1.0Un *StaticVH* Lower bond: 1.0...1.2Un *StaticVL*	0.01Un	Upper bond: 1.1Un *StaticVH* Lower bond: 0.9Un *StaticVL*
Automatic shutdown			
Parameter	Setting range	Setting step	Default value
Automatic shutdown in com loss condition	Enable / Disable	--	Disable

15. Short-circuited current of PGU

Type of power generating Unit	Information	Symbol	Value [p.u.]
PGU with full-scale converters	RMS value of the source current for three-phase fault	I_{sk}^{PF}	1.00
	RMS value of the source current for two-phase fault	$I_{(1)sk2}^{PF}$	1.00
	RMS value of the source current for single-phase fault	$I_{(1)sk1}^{PF}$	1.00
	Negative-sequence short-circuit impedance for integer k-factors	$Z_{(2)}^{PF}$	0.50

The PGU have been designed so that the requirements of VDE-AR-N 4110 and VDE-AR-N 4120 for the power generating unit can be complied with.

The prototype is an essential technical advancement or innovation.

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